



Effect of Neem (*Azadirachta indica*) leaf Supplementation on Reproductive Performance of Lactating Sahiwal Cows

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Abstract— The present study was conducted to evaluate the effect of neem (*Azadirachta indica*) leaf supplementation on reproductive performance of lactating Sahiwal cows. Twelve lactating Sahiwal cows were randomly allocated into two groups comprising a control group (T0) fed a basal diet and a treatment group (T1) supplemented with neem leaf at 200 mg/kg body weight/day for 90 days. Reproductive performance was assessed using first postpartum heat period, calving-to-conception interval, and conception rate. The mean first postpartum heat period was numerically lower in neem-supplemented cows (132.83 ± 19.81 days) than in control cows (157.20 ± 22.37 days). Similarly, the calving-to-conception interval was reduced from 166.00 ± 21.22 days in the control group to 114.67 ± 5.54 days in the neem-supplemented group. Conception rate remained comparable between the two groups (50.00%). However, the observed differences were statistically non-significant ($P > 0.05$). The numerical improvements in reproductive performance may be attributed to the antiparasitic, antioxidant, immunomodulatory, and protein-sparing effects of neem bioactive compounds, which potentially improve metabolic status and support reproductive recovery during the postpartum period. It was concluded that dietary neem leaf supplementation showed a favourable trend toward improved reproductive performance in Sahiwal cows, although further studies involving larger sample sizes and longer supplementation periods are required to confirm these effects.

Keywords— Neem leaf, Sahiwal cows, reproductive performance, postpartum heat, conception interval, conception rate.

I. INTRODUCTION

Reproductive efficiency is the cornerstone of profitable dairy cattle production, as the interval between successive calvings directly determines

lifetime milk yield, calf output, and overall economic returns from dairy enterprises. In indigenous breeds such as Sahiwal cattle (*Bos indicus*), extended postpartum anoestrus, prolonged calving-to-

conception intervals, and suboptimal conception rates are the most commonly reported reproductive constraints, collectively leading to inter-calving periods well in excess of the economically desirable twelve months. The postpartum period in dairy cows is characterised by negative energy and protein balance arising from the disproportionately high nutritional demands of early lactation relative to voluntary dry matter intake, during which the hypothalamic-pituitary-ovarian axis remains suppressed until sufficient nutritional reserves are restored (NRC, 2001). Dietary strategies that improve the availability of metabolizable protein and essential amino acids to the postpartum cow are therefore expected to facilitate earlier resumption of ovarian cyclicity and improve conception success.

Gastrointestinal parasitism is among the most significant health challenges limiting reproductive performance in cattle maintained under tropical conditions. Parasitic helminths divert host nutrients, cause hypoproteinaemia, and suppress immune function through chronic inflammatory responses, negatively affecting feed utilisation efficiency, body condition, milk production, and reproductive function in dairy animals (Kumar et al., 2013; Waller, 1997). Periparturient anthelmintic treatment has been reported to result in increased milk yield and improved milk composition in dairy cows, attributable to reduced worm burden and improved overall metabolic status (Gross et al., 1999; Borman et al., 2016). Chemical anthelmintics have conventionally served as the primary means of parasite control; however, the escalating problem of anthelmintic resistance to benzimidazoles, levamisole, and ivermectin, combined with concerns over drug residues in animal products, has necessitated the exploration of herbal alternatives (Kaplan, 2004; Terrill et al., 2001).

Neem (*Azadirachta indica*) is an evergreen tree widely distributed across tropical Asia whose leaves contain a diverse array of biologically active secondary metabolites, including azadirachtin, flavonoids, alkaloids, polyphenolic compounds, and condensed tannins, which collectively confer antimicrobial, antiparasitic, antioxidant, and immunomodulatory properties (Wylie and Merrell, 2022). Neem leaves have long been used as supplementary fodder for ruminants during dry seasons in India and other parts

of Asia (Shukla and Desai, 1988), and their medicinal potency as anthelmintic agents has been investigated in several species of livestock (Chandrawathani et al., 2006; Sarker et al., 2016). The condensed tannins present in neem leaves form stable protein-tannin complexes in the rumen that resist microbial degradation, increasing the supply of metabolizable amino acids to the small intestine – a mechanism of direct relevance to postpartum reproductive recovery, as circulating amino acids serve as precursors for reproductive hormone synthesis, uterine tissue repair, and follicular development (Makkar, 2003). Furthermore, the antioxidant and anti-inflammatory properties of neem phytochemicals are expected to attenuate periparturient oxidative stress, support uterine involution, and create a more favourable hormonal environment for resumption of postpartum cyclicity and improved conception rates.

Despite the growing evidence documenting the nutritional, anthelmintic, and immunomodulatory properties of neem leaf in ruminants, systematic studies specifically evaluating the effect of neem leaf supplementation on reproductive parameters in indigenous cattle breeds such as Sahiwal cows remain scarce. Therefore, the present study was undertaken to investigate the effect of dietary neem leaf supplementation on first postpartum heat period, calving-to-conception interval, and conception rate in Sahiwal cows.

II. MATERIALS AND METHODS

Experimental Site

The present investigation was conducted at the Bull Mother Experimental Farm (BMEF), College of Veterinary Science and Animal Husbandry, Anjora, Durg, Chhattisgarh, India. The region is located at an altitude of 317 m above mean sea level and experiences a tropical climate characterized by hot summers, moderate winters and seasonal monsoon rainfall.

Experimental Animals and Design

Twelve lactating purebred Sahiwal cows in early lactation were selected from the institute herd and randomly allocated into three groups (n = 6 per group) based on parity and body weight. Prior to the initiation of the experiment, all animals were

dewormed with fenbendazole (7.5–10 mg/kg body weight).

The experimental groups were as follows:

T0 (Control): Basal diet only

T1: Basal diet + Neem leaf (200 mg/kg bw/day)

The feeding trial was conducted for a period of 90 days.

Feeding and Management

All experimental animals were maintained under identical housing and management conditions in a conventional double-row barn system with concrete flooring. The animals were fed a basal ration comprising green fodder, dry fodder and concentrate mixture according to the farm feeding schedule. The green fodder consisted mainly of Hybrid Napier, Sudan grass, Berseem and locally available grasses. In addition, animals were allowed grazing for approximately 4 h daily during the morning. Concentrate mixture was offered twice daily during milking. Fresh drinking water was made available ad libitum throughout the experimental period.

Reproductive Parameters

Reproductive performance of experimental cows was assessed using calving to first postpartum oestrus interval, calving to conception interval and conception rate.

Calving to First Postpartum Oestrus Interval:

All cows were observed twice daily (morning and evening) for behavioral signs of oestrus following parturition. The interval between calving and the first observed postpartum oestrus was recorded and expressed in days.

Calving to Conception Interval

Table 1: Effect of Neem (*Azadirachta indica*) leaf supplementation on reproductive performance of lactating Sahiwal cows.

Parameters	T0	T1	Significance
First Post Partum Heat (Days)	157.2 ±22.37	132.83±19.81	NS
Calving to Conception Interval (Days)	166±21.22	114.67±5.54	NS
Conception Rate (%)	50	50±21.22	NS

The conception rate was identical in both groups, with 50% conception observed in the control and neem-supplemented cows. Although statistical significance was not detected, the shorter first postpartum heat

The interval from calving to successful conception was recorded for each animal using farm reproductive records and expressed in days.

Conception Rate

Conception rate was calculated as the percentage of inseminated cows that conceived during the experimental period according to the following formula:

$$\text{Conception Rate (\%)} = (\text{Number of cows conceived} / \text{Number of cows inseminated}) \times 100$$

Pregnancy status was confirmed through routine pregnancy diagnosis records maintained at the farm.

Statistical Analysis

Data were analysed using SPSS statistical software. Treatment means were compared by one-way analysis of variance (ANOVA) as described by Snedecor and Cochran. Differences were considered statistically significant at $P < 0.05$.

III. RESULTS

Effect of Neem Leaf Supplementation on Reproductive Performance of Sahiwal Cows

The reproductive performance of cows in the control and neem-supplemented groups is presented in Table X. The mean interval to first postpartum heat was lower in the neem-supplemented group (132.83 ± 19.81 days) compared to the control group (157.20 ± 22.37 days). Similarly, the calving-to-conception interval was reduced in the neem-supplemented group (114.67 ± 5.54 days) compared to the control group (166.00 ± 21.22 days). However, the differences in both parameters were statistically non-significant ($P > 0.05$).

interval and calving-to-conception interval observed in the neem-supplemented group suggest a positive influence of neem supplementation on reproductive efficiency.

Overall, neem leaf supplementation showed a favourable numerical effect on reproductive performance, particularly by reducing the calving to conception interval and advancing the onset of first postpartum estrus; however, these improvements were not statistically significant.

IV. DISCUSSION

Effect of Neem Leaf Supplementation on Reproductive Parameters in Sahiwal Cows

The present study demonstrated numerically favourable improvements in first postpartum heat period, calving-to-conception interval, and conception rate in neem-supplemented Sahiwal cows, although the differences did not attain statistical significance ($p > 0.05$). The numerical improvements observed are biologically plausible and mechanistically consistent with the diverse pharmacological properties of neem leaf bioactive constituents including azadirachtin, flavonoids, polyphenolic compounds, and condensed tannins, which collectively confer antimicrobial, antiparasitic, antioxidant, and immunomodulatory properties (Wylie and Merrell, 2022; Ramesh et al., 2011).

Cows supplemented with neem leaf exhibited a numerically shorter first postpartum heat period (132.83 ± 19.81 days) compared to the control group (157.20 ± 22.37 days), indicating earlier resumption of ovarian activity following calving. This finding is attributable primarily to the anthelmintic properties of neem leaf, as gastrointestinal parasitism is a well-recognised suppressor of postpartum ovarian activity in tropical cattle. Parasitic helminths divert host dietary nutrients, cause hypoproteinaemia, and suppress hypothalamic-pituitary-ovarian axis activity through chronic inflammatory pathways (Waller, 1997; Kumar et al., 2013). Chandrawathani et al. (2006) confirmed that daily feeding of fresh neem leaves to sheep effectively controlled gastrointestinal worm burden without adverse effects on animal health, while Sarker et al. (2016) reported that neem leaf supplementation at 200 mg/kg live weight in cows resulted in a 78.95% increase in milk yield compared to untreated controls, with anthelmintic efficacy comparable to albendazole treatment. By reducing parasitic burden, neem supplementation is expected to restore circulating protein concentrations and

improve the metabolic status necessary for timely resumption of postpartum ovarian cyclicity.

The immunomodulatory and antioxidant properties of neem phytochemicals additionally support earlier postpartum reproductive recovery. The periparturient period in dairy cows is characterised by marked immunosuppression and elevated oxidative stress, both of which delay uterine involution and suppress GnRH pulsatility (Harmon, 1994). Singh et al. (2019) demonstrated that a polyherbal formulation containing neem significantly improved somatic cell count profiles in cows with subclinical mastitis, attributing the beneficial effect to the anti-inflammatory activity of neem polyphenolics that suppress pro-inflammatory cytokine signaling. By attenuating postpartum inflammatory burden and oxidative stress, neem leaf supplementation is expected to support more rapid uterine involution and earlier restoration of hypothalamic sensitivity, facilitating the pre-ovulatory LH surge and first postpartum ovulation. Furthermore, the condensed tannins in neem leaves form stable rumen bypass protein complexes that resist microbial degradation but dissociate in the abomasum, releasing metabolizable amino acids for absorption in the small intestine (Makkar, 2003). This improved protein supply supports insulin-like growth factor-1 synthesis and gonadotropin secretion, both critical stimulators of postpartum follicular development. Taethaisong et al. (2023) confirmed in goats that neem leaf supplementation significantly improved nitrogen absorption and retention while simultaneously reducing ruminal protozoa and methanogen populations, indicating a superior rumen environment conducive to efficient dietary protein utilization with direct downstream benefits for reproductive function.

The numerically reduced calving-to-conception interval in neem-supplemented cows (114.67 ± 5.54 days vs 166.00 ± 21.22 days in controls) reflects the cumulative effect of earlier first postpartum oestrus and improved uterine receptivity at the time of service. El-Zaiat et al. (2022) demonstrated in Omani lambs that dietary neem leaf powder significantly increased blood total protein and globulin concentrations while reducing blood urea nitrogen compared to control animals, indicating more efficient utilization of dietary nitrogen with amino acids

redirected toward reproductive hormone production rather than catabolism and urinary excretion. Higher circulating protein concentrations support corpus luteum formation, progesterone secretion, and uterine environment maintenance for early embryonic development – all prerequisites for successful conception. The direct relevance of improved hormonal status to reproductive outcomes is further supported by Ibrahim et al. (2024), who demonstrated that nutritional supplementation improving systemic protein and metabolic status significantly elevated blood estradiol (17.71 vs 14.32 pg/ml) and progesterone (1.35 vs 0.53 ng/ml) concentrations in growing heifers, with supplemented animals attaining puberty earlier than controls, underscoring the sensitivity of the reproductive endocrine axis to improvements in nutritional status. Njoga et al. (2022) further noted that neem phytochemicals directly influence steroidogenic pathways in reproductive tissues and may modulate estrogen and progesterone metabolism, with implications for oocyte maturation, fertilisation, and early embryonic survival.

The conception rate in the neem-supplemented group ($50.00 \pm 21.22\%$) was comparable to the control group, which may be attributable to the limited number of experimental animals and the inherently high individual variation in conception responses among postpartum dairy cows. Raj et al. (2016) similarly reported that despite significant improvements in milk yield in cows receiving neem cake-incorporated total mixed rations, some parameters showed non-significant differences attributable to individual animal variation. The non-significant results across all reproductive parameters may also reflect the relatively short supplementation period and the time lag required before the full biological effects of neem phytochemicals on the reproductive endocrine axis are fully expressed. Future studies employing larger sample sizes, longer pre-calving supplementation periods, and concurrent measurements of blood metabolites, oxidative stress markers, and hormonal profiles are warranted to fully characterise the reproductive benefits of neem leaf supplementation in indigenous dairy cattle breeds.

V. CONCLUSION

Dietary supplementation of neem (*Azadirachta indica*) leaf at 200 mg/kg body weight/day for 90 days exerted a favourable numerical influence on reproductive performance in lactating Sahiwal cows. Neem-supplemented cows exhibited a shorter first postpartum heat period and a reduced calving-to-conception interval compared with control cows, indicating improved reproductive efficiency. Although conception rate remained unchanged and the differences among treatments were statistically non-significant, the observed trends suggest that neem leaf supplementation may support postpartum reproductive recovery through its antiparasitic, antioxidant, immunomodulatory, and nutritional effects. The findings indicate that neem leaf has potential as a natural feed additive for improving reproductive performance in indigenous dairy cattle. However, further investigations involving larger populations, longer experimental periods, and detailed evaluation of metabolic and reproductive hormones are recommended to establish its efficacy conclusively.

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